

Name: \_\_\_\_\_

Period: \_\_\_\_\_

**The final exam will consist of questions from the following units:**

Mole Conversions and Stoichiometry

States of Matter

The Behavior of Gases

Solutions

Acids and Bases

Redox Reactions

**Mole Conversions and Stoichiometry:**

- Determine the number of liters in 1 mole of any gas
- Determine the number of atoms in 1 mole of any substance
- Determine the number of grams in 1 mole of any substance
- Describe the importance of a mole ratio
- Complete one and two step conversions using volume, mass, moles, and atoms (one-step as well as multi-step conversions)
- Given the mass or volume of one component of a chemical reaction, solve for the mass or volume of a second component

**States of Matter:**

- Describe the five points of the Kinetic Molecular Theory and how they relate to solids, liquids, and gases
- Compare and contrast solids, liquids, and gases in terms of energy, motion, density, shape, volume and compressibility
- Identify all six phase changes and describe what is happening during each change in terms of heat and energy of particles
- Compare and contrast the four types of intermolecular forces (IMF's) in terms of strength and where they are found
- Determine the relationship between atmospheric pressure and boiling point
- Define equilibrium, explain under what conditions can it exist, and the processes that are taking place when it does exist

**Gases and Their Properties:**

- Define STP
- Convert between degree Celsius and Kelvin
- Convert between units of pressure and volume
- Solve all gas law problems (Boyle, Charles, Guy Lussac, Combined, Ideal)

**Solutions:**

- Define solute and solvent and differentiate between the two
- Determine which substances will dissolve the fastest (or slowest)
- Describe the various ways to increase the dissolution of a solid in water
- Describe the relationship between temperature and the solubility of gases in water
- Describe the relationship between temperature and the solubility of solids in water
- Differentiate between an electrolyte and non-electrolyte solution
- Determine what substances will dissolve in each other (relate to terms of polarity)
- Calculate the following:
  - Molarity
  - Molality
  - Weight by percent
  - Dilution
- Complete questions using a solubility chart
- Describe how certain solutes will affect the freezing and boiling points of a solvent
- Calculate the freezing and boiling points of solutions

**Acids and Bases:**

- List the properties of acids and bases
- Describe Arrhenius acids and bases
- Describe Bronsted-Lowry acids and bases
- Differentiate between conjugate acid and conjugate base
- Determine the conjugate acid-base pairs in a chemical reaction
- List the six strong acids and seven strong bases (both names and formulas)
- Differentiate between monoprotic, diprotic, and triprotic
- Calculate pH, pOH,  $[H^+]$ , and  $[OH^-]$  using the given equations
- Determine if a substance is acidic or basic based on its respective pH, pOH,  $[H^+]$ , or  $[OH^-]$
- Describe how the pH scale compares the acidity of any two substances, given their respective pH values
- Determine the products of a neutralization reaction, and solve titration problems

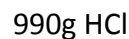
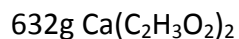
**Redox Reactions:**

- Assign correct oxidation numbers (charges)
- Define oxidation and reduction
- Identify the oxidation and reduction half reactions

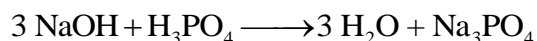
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## Practice Problems

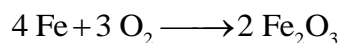
1. Determine the number of moles in each of the following:



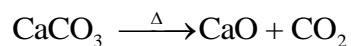
2. Calculate the mass of  $\text{NaOH}$  is needed to react with 196g of  $\text{H}_3\text{PO}_4$  in order to produce water and sodium phosphate according to the following reaction:



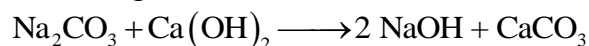
3. Calculate the mass of  $\text{O}_2$  that is needed to react with 112g  $\text{Fe}$  to make iron (III) oxide?



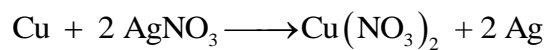
4. Calcium carbonate,  $\text{CaCO}_3$ , decomposes and produces 2.26g calcium oxide,  $\text{CaO}$ . If the theoretical yield is 2.68g, what is the percent yield?



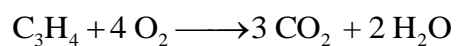
5. Calculate the mass of  $\text{CaCO}_3$  produced when 254 grams of  $\text{Na}_2\text{CO}_3$  are reacted according to the following reaction:



6. Calculate the mass of Cu needed to produce 2.25 g Ag according to the following reaction:



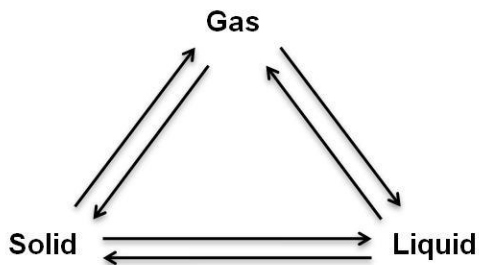
7. Calculate the volume of oxygen gas needed to produce 6.5 Liters of  $\text{CO}_2$  according to the following reaction:



Complete the following table

	Solid	Liquid	Gas
Definite volume? (Y/N)			
Fluid? (Y/N)			
Compressible? (Y/N)			
Attractive forces between molecules (strong/medium/none)			
Speed of molecules			
Thermal expansion			

8. Label the following diagram:



9. What does the term dynamic equilibrium mean? Which system is at dynamic equilibrium – a closed water bottle or an open one?
10. Water boils at 100 °C while methane (CH<sub>4</sub>) boils at -161 °C. Both have similar masses. Explain using KMT, specifically intermolecular forces, why water boils at a higher temperature.
11. Where will water boil at a higher temperature – Mount Everest or New Orleans? Explain.
12. How are the Kelvin temperature scale and kinetic energy related?
13. What are STP conditions?
14. The initial temperature of a gas is 43°C. Calculate the final temperature if the volume changes from 500mL to 350mL at constant pressure?

15. Calculate the original volume of a gas at  $-10^{\circ}\text{C}$  if the final volume of gas is 200 gallons at  $25^{\circ}\text{C}$  and pressure is held constant?
16. Calculate the final pressure on a balloon if its volume changes from 250 L at 770 mm Hg to 1000 L with constant temperature?
17. A rigid vessel of gas at STP is heated to  $900^{\circ}\text{C}$ . Calculate the new pressure.
18. Underline the solvent in each of the following solutions
- a. A solution containing 10.0 g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and 500.0 g of water
  - b. A solution containing 60.0 mL of ethyl alcohol and 30.0 mL of methyl alcohol
  - c. 5 quarts of water and 1 quart of antifreeze
  - d. 5% sodium hypochlorite and 95% water
  - e. 2% milk fat and 98 % water

19. Complete the following table using the combined gas law:

Parameter	Initial	Final
Temperature	23°C	58°C
Volume	360mL	150mL
Pressure	230 torr	?
Temperature	Standard	105°C
Volume	5L	?
Pressure	Standard	2 atm
Temperature	30°C	Standard
Volume	300mL	?
Pressure	795 mm Hg	Standard

20. Why does water not dissolve motor oil?

21. In which solution is the solubility of a gas higher – cold water or hot water?

22. What three things can you do to get sugar to dissolve faster in water?

23. When a solute is added to water, what happens to the freezing point? To the boiling point?

24. Which will freeze at a lower temperature – a 1.5 m solution of NaCl or a 1.5 m solution of MgCl<sub>2</sub>?

25. Which will boil at a higher temperature – a 1.5 m solution of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> or a 1.5 m solution of NaCl?

26. Calculate the molarity of a solution if 236g of HI is dissolved in 17,500mL of solution?

27. Determine the mass of solute in 2000mL of a 0.25M solution of  $\text{CuSO}_4$ .
28. Calculate the molarity of 114g  $\text{Al}_2(\text{SO}_4)_3$  in 1500mL of solution.
29. Calculate the weight of KBr needed to make 200g of a 5% solution.
30. Calculate the mass of solute is needed to make 350mL of a 0.1M solution of  $\text{C}_2\text{H}_5\text{OH}$ .
31. Calculate the molality of a solution in which 115g  $\text{AlCl}_3$  in 1500g water.
32. What would be the freezing point and boiling point of the solution in #18
33. Calculate the pH and pOH of the following solutions:
- |                         |                                  |
|-------------------------|----------------------------------|
| 0.00001M $\text{HNO}_3$ | 0.00254M $\text{HCl}$            |
| 0.001M $\text{KOH}$     | 0.0035M $\text{H}_2\text{SO}_4$  |
| .00002M $\text{HCl}$    | 0.00044M $\text{H}_2\text{SO}_4$ |
34. Calculate the pOH, hydronium ion, and hydroxide ion concentration for a solution with a pH of 5 and a solution with a pH of 12.35.



35. Identify the conjugate base for the following:

- a.  $\text{HCl}$
- b.  $\text{H}_2\text{SO}_4$
- c.  $\text{H}_2\text{O}$

36. Identify the conjugate acid for the following

- a.  $\text{NO}_3^-$
- b.  $\text{NH}_3$
- c.  $\text{H}_2\text{PO}_4^-$
- d.  $\text{H}_2\text{O}$

37. Label the acid, base, conjugate acid and conjugate base for the following:

- a.  $\text{HCN}(aq) + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{CN}^-(aq)$
- b.  $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$

38. During a titration process, 35mL of 2.0M  $\text{H}_2\text{SO}_4$  neutralizes exactly 20.0mL of  $\text{NaOH}$ .

- a. Predict the products
- b. Balance the equation
- c. Label the acid, base and salt
- d. Name the salt
- e. Calculate molarity of the base solution.

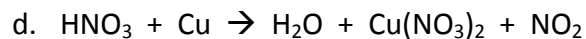
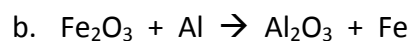
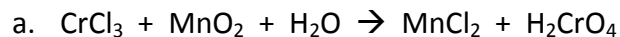
39. Complete the following for the neutralization reaction between NaOH and HCl.

- Predict the products
- Balance the equation
- Label the acid, base and salt
- Name the salt
- If 15.2 mL of a 1.7 M NaOH solution are needed to neutralize 22 mL of HCl, what is the molarity of the HCl?

40. How can you identify an Arrhenius (Traditional) acid from its formula? An Arrhenius base?

41. For the following equations:

- Assign oxidation numbers to all atoms
- Identify which element is oxidized and which is reduced



42. Use the solubility curve chart to answer the following:

- a. How many grams of  $\text{Ce}_2(\text{SO}_4)_3$  will dissolve in 100 g  $\text{H}_2\text{O}$  at  $10^\circ\text{C}$ ?
- b. How many grams of  $\text{NaNO}_3$  will dissolve in 100 g  $\text{H}_2\text{O}$  at  $60^\circ\text{C}$ ?
- c. How many grams of  $\text{NH}_3$  will dissolve in 100 g  $\text{H}_2\text{O}$  at  $90^\circ\text{C}$ ?
- d. Identify the following solutions as saturated, unsaturated or supersaturated:
  - i. A solution of  $\text{KClO}_3$  at  $40^\circ\text{C}$  contains 45 g in 100 g  $\text{H}_2\text{O}$ .
  - ii. A solution of  $\text{NH}_4\text{Cl}$  at  $40^\circ\text{C}$  contains 45 g in 100 g  $\text{H}_2\text{O}$ .
  - iii. A solution of  $\text{KNO}_3$  at  $40^\circ\text{C}$  contains 45 g in 100 g  $\text{H}_2\text{O}$ .
- e. How many grams of  $\text{KNO}_3$  can be added to 100 g of  $\text{H}_2\text{O}$  if the temperature is increased from  $0^\circ\text{C}$  to  $60^\circ\text{C}$ ?
- f. How many grams of  $\text{KCl}$  will precipitate out of 100 g of water that is cooled from  $80^\circ\text{C}$  to  $20^\circ\text{C}$ ?

